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Measuring High Reliability Characteristics of the Organization

Paul J. Berardi

Kansas City, Missouri Fire Department

Abstract

Firefighting is dangerous, complex, dynamic and operational tasks are interdependent and performed under rapidly changing conditions. Research has identified that High Reliability Organizations (HRO) conduct similar operations for long periods of time disaster free. The Kansas City, Missouri Fire Department (KCFD) has suffered 12 line of duty deaths in the past 24 years, and continues to realize injuries and near-miss occurrences at a troubling rate. The purpose of this research was to identify common characteristics of high reliability organizations, identify how well KCFD measures up to these characteristics, and to identify opportunities for developing these characteristics within KCFD to reduce error rates and strengthen safe operations. This research uses descriptive research methodology. A questionnaire was developed and using a template from the research literature to measure KCFD's tendencies towards HRO characteristics. The questionnaire was distributed to KCFD chief officers. The respondents indicated that that KCFD had strong disposition towards HRO characteristics, but also indicated some areas of weakness. Recommendation to improve HRO characteristics inside KCFD.

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Introduction

Much like the fire service as a whole, the Kansas City, Missouri Fire Department (KCFD) addresses safety issues by reviewing significant incidents, developing policy, training and policy enforcement. And like the rest of the fire service, KCFD continues to realize injuries and near-miss occurrences at a troubling rate. There is a large body of research that suggests certain organizations, referred to as High Reliability Organizations (HROs), perform high-risk operations disaster free for long periods of time, making consistently good decisions that result in higher quality, safer and more reliable operations (Fratus, 2007). HROs have specific common characteristics that can be developed within an organization to reduce error. The problem was that the KCFD had not evaluated common characteristics of HROs within the department and therefore did not know if it was feasible to develop these characteristic inside KCFD.

The purpose of this study was to identify common characteristics of high reliability organizations, identify how well KCFD measures up to these characteristics, and to identify opportunities for developing these characteristics within KCFD to reduce error rates and strengthen safe operations. This research uses descriptive research methodology. The research questions were (a) according to existing literature, what are the common characteristics of HROs, (b) how well does KCFD exhibit the identified characteristics of a HRO, (c) what are KCFD's limitations as they relate to the identified HRO characteristics, and (d) what opportunities exist for KCFD to develop these HRO characteristics?

Background and Significance

The City of Kansas City, Missouri, covers 314 square miles, has a population of 447,306 (U.S. Census Bureau, 2000) and is the hub of a diversely populated metropolitan area. The Kansas City metropolitan area overlaps several counties in two states, and is home to 1.8 million people. With an annual operating budget of $97.35 million (Office of Management and Budget, 2009), the Kansas City, Missouri Fire Department operates 54 fire apparatus from 34 firehouses with 1003 fulltime employees. The department is a career department and provides principle services of fire protection, basic life support, emergency medical service, rescue and hazardous materials response. KCFD is segmented into six bureaus which include: Community Services, Professional Development, Technical Services, Special Operations and Emergency Operations. Each bureau is managed by a deputy chief, who along with the fire chief makes up the Fire Administration staff. The department operates within a labor/management partnership that exists between Fire Administration and Locals 42 and 3808 of the International Association of Fire Fighters. Local 42 represents the rank and file personnel of the department and Local 3808 represents the battalion chiefs and middle management personnel of the organization. This partnership is designed to include the labor force as a participant in every significant decision within the department concerning policies and programs. Through May 1, 2007 and April 30, 2008, KCFD responded to 48,516 calls for service. Of the total number of calls for service, 2,842 were fire-related incidents and 1,174 of the fire-related calls were reported structure fires (Technical Services Bureau, 2008).

Kansas City's public safety entities enjoy strong public support as evident by the annual satisfaction surveys. Since the year 2000, an average of 72% of Kansas City citizens who

responded to the question of overall satisfaction with police, fire and ambulance services, reported they were either satisfied or very satisfied (City Auditors Office, 2008).

Emergency operations of any type are complex, dynamic and require that several technical tasks be simultaneously coordinated and performed under severe time pressure. The nature of firefighting is inherently hazardous and not unlike others across the county who are drawn to the excitement, camaraderie and the status of a career as a firefighter, individuals who are impelled to serve the City of Kansas City as a firefighter knowingly accept and are attracted to the risks of the job. “In general, firefighters were found to be keenly aware of the hazards associated with their occupation.” (Bellrose & Pilisuk, 1991, p. XX) In their study regarding vocational risk acceptance, Bellrose and Pilisuk identified that even though firefighters were well aware of the hazards they face, they were also exceptionally satisfied with their job. Firefighters cited inclusion into a supportive team environment, their heroic image, and community involvement as reasons for their job satisfaction. The desire to be part of the KCFD team was identified as the number one attraction of KCFD firefighter applicants (Kansas City, Missouri Fire Department, 2007a). Moreover, as new cadets are trained and indoctrinated into the culture of the department, acceptance of risk becomes embedded in their way of thinking. The indoctrination process does not end with cadet training or even with the early years, but continues throughout ones career as social bonds develop. This spree de corps is then passed down to the next generation of firefighters. This is not to suggest that KCFD tolerates or even tacitly approves reckless behavior, but the fact is that the department has suffered 82 line-of-duty-deaths (LODD) since 1918 and 12 LODDs in this author’s 24 year career. The willingness of firefighters to face the inherent danger of the job is a keystone component of the strong social bonds of the KCFD team, and this bond is essential to the department’s mission and identity. It is

because people are mission driven, in spite of the inherent risks that KCFD's leadership is rightfully obligated to continuously strive for a safer organization. In spite of continuous effort through, hazard awareness, training and policy development, and enforcement, however, KCFD continues to experience near-miss fireground events at an unacceptable rate.

Within the past 30 months, KCFD experienced two significant flashover fires that resulted in severe burns to multiple firefighters at each incident. Both events were dangerously close to being classified as multiple line of duty death (LODD) fires. Through a well developed after action review (AAR) process, the department analyzes significant incidents to identify organizational learning opportunities. An (AAR) is an assessment conducted after a significant incident that enables the department to discover what happened and why (Kansas City, Missouri Fire Department, 2006).

The first incident occurred on February 16, 2007. Five firefighters were seriously injured battling a blaze in a historic building in the Waldo area of Kansas City, Missouri. News reports noted that "Fire Chief Smokey Dyer called it a terrible day for the department but said the outcome could have been much worse." (Kansas City News, KMBC, 2007). The authors of the AAR report recommended that to minimize the possibility of similar occurrences, the "department should demand, that from the inception of all incidents, the Incident Commander perform his/her command duties from a position that affords the best overall scene management and supervision" (Kansas City, Missouri Fire Department, 2007b, p. 6). Lapses in communications, and risk analysis were also identified as significant contributing factors. As a result of the report's recommendations, KCFD developed General Operational Guideline (GOG) 10-1.1 *IMS Expectations for company officers*, (Kansas City, Missouri Fire Department, 2008) and conducted thorough department-wide training regarding the department's expectations of

incident management system (IMS). Subsequent to the GOG's effective date, the department's leadership was committed to enforce the policy that dictates the first arriving company officer must function as the incident commander without getting involved in tactical operations until Command has been properly transferred. To enforce the policy, it was not uncommon for a battalion chief to receive praise or counseling from his/her deputy chief depending on their company officers' performance meeting the department's IMS expectations. Moreover, if the policy was being ignored in a battalion chief's district or by a particular company officer, the battalion chief and the company officer would receive counseling and reprimand directly from the fire chief.

In spite of the department's focus on IMS practices and on-scene safety, 30 months later, a strikingly similar incident occurred. On October 18, 2009 two firefighters were burned during a rapid fire progression in a vacant two story apartment building. The AAR report cited lapses in communication, incident commander location, and risk analysis as contributing factors. (Kansas City, Missouri Fire Department, 2009). While not the subject of this research, it is important to note that these incidents also have in common the fact that if not for the truly heroic actions of firefighters on the scene who made incredible rescues, both fires would have unquestionably resulted in line of duty deaths. (Kansas City, Missouri Fire Department, 2009)

The evidence does not indicate that lack of experience was a contributing factor in either incident. Respected, veteran company officers were present in decision making roles, at both fires and the 2009 fire was commanded by a respected battalion chief. The department's culture of willingness to accept inherent risks by mission-driven firefighters, who have successfully responded to countless similar looking fires, may dissuade firefighters from questioning what an

acceptable risk is and ultimately may inhibit the department's ability to avert reoccurring breakdowns and progression towards safer operations.

Reoccurrences of the same types of breakdowns or failures that result in firefighter death or injury are not unique to KCFD. Since 1998, the National Institute for Occupational Safety and Health (NIOSH), through their Fire Fighter Fatality Investigation and Prevention Program, conduct independent investigations of fire fighter line-of-duty deaths to formulate recommendations for preventing future deaths and injuries. These reports repeatedly identify the same types of failures. Of nineteen NIOSH fatality reports published in 2007 and 2008, where the cause of death was a traumatic occurrence at a fire scene, recommendations for many of the same type of breakdowns or failures appear again and again. For example, of these nineteen incidents, ten of the LODD reports cited lack of, or weak Incident Command as a contributing factor. Seven cited a lack of thermal imaging camera, six cited lack of an assigned safety officer, and five identified the lack of proper risk assessment. Additionally, there were several other repeated lessons learned cited as contributing factors in these nineteen reports (National Institute for Occupational Safety and Health, 2009).

Emergency fireground operations are complex, dynamic, inherently hazardous and believers of normal accident theory (NAT) would suggest that the question is not whether if, but when, fireground operations will result in traumatic accidents resulting in firefighter line of duty deaths (Perrow, 1984). Anecdotally, some KCFD firefighters agree with the normal accident theory. Comments from on scene crews made during the after action reviews of both of the incidents that were outlined above are bothersome. When the question of, what would we do differently if faced with the same situation? The recollection of the author is that the sentiment from both groups is that they would do nothing differently. They indicated that the job is

inherently dangerous and sometimes accidents happen. Students of HROs, on the other hand, argue that it is possible for organizations continually to delay or even permanently defer the inevitable failures through effective organization (Roberts, 1990). Roberts and Bea (2001) subsequently wrote, “Accidents are normal in the sense that they aren’t likely to be eliminated on either a system or organizational level. The lessons learned from HROs offer promise that all organizations can benefit from attending to these issues.” (p. 77). The latter research indicates that there is a reasonable moderate position; all risk will not be eliminated but it is possible to develop into safer organizations.

The HRO research of many different occupational fields suggests that organizations that develop the capability for mindfulness will be better prepared to manage unexpected events and reduce the number of errors. This applied research project is related to the National Fire Academy’s (NFA) Executive Analysis of Fire Service Operations course in that it will identify organizational characteristics of high-reliability organizations and how to develop those characteristics inside KCFD which could result in increased operational efficiencies. A reduction in the number of errors and lessening the intensity of their affect will increases firefighter safety which aligns with the United States Fire Administration’s (USFA) operational objective of reducing the loss of life from fire of firefighters.

Literature Review

The concept of organizational reliability has been somewhat controversial within the HRO literature. Few disagree that the reliability of an organization is the ability to repeatedly generate outcome with relatively small variance (Hannan & Freeman, 1984). Research has moved from the extreme positions of Perrow (1984) who wrote accidents are inevitable in complex organizations with interdependent parts, and early Roberts (1990), who wrote

organizations can permanently defer the inevitable failures. The more recent research has embraced higher-reliability as a performance variable rather than reliability as a defining characteristic. Rochlin, La Porte and Roberts' (2005) study agrees:

> … studies of large, formal organizations that perform complex, inherently hazardous, and highly technical tasks under conditions of tight coupling and severe time pressure have generally concluded that most will fail spectacularly at some point, with attendant human and social costs of great severity. The notion that accidents are "normal", that is to be expected given the conditions and risks of operation, appears to be well grounded in experience as in theory. Yet there is a small group of organizations in American society that appears to succeed under trying circumstances performing daily a number of highly complex technical tasks in which they cannot afford to "fail." (p. 1)

In their study, they offer aircraft carrier flight operations at sea as an example whereby devotion to zero rate of error is almost matched by performance. To identify high reliability organizations, one can ask, "how many times could this organization have failed resulting in catastrophic consequences that it did not?" (Roberts, 1990, p. 160) The higher that number is the higher reliability the organization. Naval "flight operations at sea is the closest to the "edge of the envelope" --operating under the most extreme conditions in the least stable environment, and with the greatest tension between preserving safety and reliability and attaining maximum operational efficiency." (Rochlin 2005, p.1) The study also points out that the Navy does this with a young and largely inexperienced crew, and with a staff of officers that turns over half its compliment each year. This study as well as other studies of fast-paced, high-hazard processes reveal that organizations classified as HROs perform complex, dangerous processes for long

periods of time without major catastrophe. Weick and Sutcliffe (2001) outline five characteristics or processes by which HROs operate that result in reliability when reacting to unexpected events.

> HROs manage the unexpected through five processes: (1) preoccupation with failures rather than successes, (2) reluctance to simplify interpretation, (3) sensitivity to operations, (4) commitment to resilience, and (5) deference to expertise, as exhibited by encouragement of a fluid decision-making system. Together these five processes produce a collective state of *mindfulness*. To be mindful is to have a rich awareness of discriminatory detail and enhanced ability to discover and correct errors that could escalate into a crisis. These five processes are the fundamentals that are the basis of improvements in quality, reliability, and productivity in any organization. (pp. 3-4)

To be preoccupied with failures rather than success means that HROs encourage reporting of errors, they sweat the small stuff, they use a robust feedback system, and they treat even small mistakes as a symptom that something is wrong with the system. KCFD uses a general administrative guideline for conducting after action reviews. “After Action Reviews can be requested by anyone in the organization, they can be informal or formal and should be conducted at the level that is appropriate for the complexity of the training exercise or incident” (Kansas City Fire Department, 2008, p. 1). Weick and Sutcliffe (2001) provide an example of a great leader in history who acknowledged the principal of consciously auditing mistakes.

> During World War II Churchill made the horrifying discovery that Singapore was far less impregnable than he thought and was actually highly vulnerable to a Japanese land invasion. Reflecting on this unexpected discovery, Churchill commented in his history of the war, “I ought to have known. My advisors ought to have known and I ought to have

> been told, and I ought to have asked." Churchill's audit consisted of four questions: Why didn't I know, why didn't my advisors know, why wasn't I told, why didn't I ask? (p. 85)

Here is a firefighting illustration similar to Churchill's situation. A firefighter suffered an unwitnessed sudden cardiac death while fighting a wildland fire. The victim was found unconscious and without a pulse approximately 15 minutes later (National Institute for Occupational Safety and Health, 2000). KCFD's General Operations Guideline on may-day communications states "When you become lost, activate a "MAY-DAY" as soon as possible" (Kansas City, Missouri Fire Department, 2004). In the absence of any such announcement the incident commander will assume all is going well. This violates two of Churchill's four requirements. If one interchanges the IC for Churchill, it violates the requirement that the IC should have been informed and it violates that the IC should have inquired. If the IC hears nothing, he/she is to assume things are fine. But another reason the IC may not hear anything is that things are not fine. If the person who is to report is incapacitated, things are not fine and the IC is unaware. Weick and Sutcliffe (2001) suggest that this situation bumps up to the organization's default position. What does it mean when there is no news? Does it mean things are going well or things are going poorly? The default answer tells something important about the degree to which the organization is mindful and likely to deal with unexpected events.

The next characteristic is the reluctance to simplify an explanation of a mistake. This means that the HROs take deliberate steps to create a complete picture. They encourage diverse experience and differences of opinion without destroying nuances that diverse people detect. HROs understand that a simple answer to a complex problem may indicate a less than full understanding of the problem.

The third characteristic of an HRO is that they are sensitive to operations; they want to know how things work, not just how they are supposed to work. HROs are attentive to the front line where the work gets done. They treat deficiencies in normal operations as “free lessons” that signal the development of unexpected events. A commitment to resilience means that they develop systems to detect and bounce back from the unexpected errors. HROs develop behaviors that allow individuals and their organizations to be resilient. HROs approach unplanned events in terms of mitigation and rapid recovery. Weick and Sutcliffe (2001) offer the following:

> …high reliability organizations maintain reliable performance despite constant exposure to the unexpected, in part by developing and maintaining their capability of mindfulness. A well developed capability for mindfulness catches the unexpected earlier, when it is smaller, comprehends its potential importance despite the small size of the disruption, and removes, contains or rebounds from the effects of the unexpected.

The final characteristic of HROs outlined by Weick and Sutcliffe (2001) is that they have deference to expertise. HROs push decision making down to the front line and decisions are made by the people with the most expertise. They understand that decisions made by those with the most expertise are likely to be more timely and correct.

Operating by these principles is not foreign to the fire service. Whether the label of HRO is attached or another label such as Incident Management System (IMS) or after action review, fire service leaders have professed the critical need to operate using similar protocol. Moreover, for the past few years, HRO research has appeared in the writings of students of the structural fire service. For example (Fratus, 2007). Furthermore, the wildland firefighting community has taken affirmative steps to further their high reliability operations. At a regular workshop on the subject in 2006, *High-Reliability Organizing – Managing the Unexpected in Wildland Fire*

Operations, the keynote address was entitled; *Our challenge: being a true high-reliability organization*. "High Reliability Organizations (HROs) are built on integrity, nurtured by culture, and refined by in the fire of performance. HROs are also clear on the value of public trust" (Harbor, 2007, p. 1).

Procedures

The purpose of this study was to identify characteristics, common of highly reliable organizations, identify the strengths and weaknesses of KCFD as they relate to those characteristics, and to identify opportunities to develop those characteristics inside KCFD. A literature review and a quantitative application were used to answer the four questions that guided this research.

The author began the research by reading *On the fireline: Living and dying with wildland firefighters* (Desmond, 2007). The book is an ethnographic account of wildland firefighters and their acceptance of risk. This led to an internet Google search for "firefighter risk acceptance". The literature review continued with material collected from the internet search, the Kansas City, Missouri Public Library, interdepartmental investigative reports, and previous Executive Fire Officer (EFO) applied research projects accessed from the Learning Resource Center at the National Fire Emergency Training Center in Emmitsburg, Maryland.

Question One: According to existing literature, what are the common characteristics of HROs? To answer this question, a thorough review of research and literature on the subject was conducted.

Questions Two and Three: How well does KCFD exhibit theses characteristics and what are the limitations related to the identified HRO characteristics? To answer these questions, a 55 item, rating scale questionnaire was developed using Weick and Sutcliffes' (2001) audit tool as a

template. "You can use these items to craft additional items that may be more sensitive to the idiosyncrasies of your firm…If customizing some of these items helps you make that assessment, feel free to do so" (p. 87). The 55 customized items were divided into six sections. The first set of items was to assess overall mindfulness of KCFD related to safety. Each of the next five sets of items was intended to assess KCFD's strengths and weaknesses related to the five characteristics of HROs. The five characteristic-focused categories had a separate heading and instructions and each contained eight to twelve items. The instructions for five of the six sections were simply "… please indicate how well each statement describes KCFD." The forced responses; not at all, to some extent, and a good deal, were weighted 1, 2, 3 respectively. The instructions for the Sensitivity to Operations characteristics section was for the respondent to indicate whether they agreed or disagreed with the statement (see Appendix A - F for the entire questionnaire).

For ease of distribution, questionnaire items were configured into the on-line survey tool, *SurveyMonkey.com.* The survey link was emailed from the author's personal email account, paul_berardi@yahoo.com, to the City of Kansas City email addresses of 100% of KCFD's chief officers. This includes seven deputy chief and 28 battalion chief officers. The survey took approximately ten minutes to complete and the results were automatically collated by *SurveyMonkey.com.* The responses were tabulated and the average score per respondent as well as the point range indicating relative strength or weakness of the characteristic was entered in Table 1. Weick and Suttcliffe (2001) offer point ranges that determine the strength of the characteristic measured.

Question Four: What opportunities exist for KCFD to develop these HRO characteristics? To answer the final question, the author evaluated the responses to the questionnaire to

determine what opportunities existed to KCFD to develop these HRO characteristic. The information gained from administering the questionnaire is straightforward. Essentially, the more the respondents indicated that the characteristic described KCFD, the closer to reliability. The less that the respondents indicated the characteristics described KCFD, the more work is required to move KCFD to reliability. Using Weick and Sutcliffes'(2001) scoring guidelines, that suggest ranges of scores that indicate high, moderate, or low commitment to the characteristic, the next step was to evaluate the abilities and liabilities of KCFD against those ranges.

A limitation of this research is that, due to the two recent serious near-miss incidents, there is a heightened awareness to safety within KCFD which may have skewed the chief officers' responses to the questionnaire. Moreover, it is unclear how this situation may have skewed the results. For example, this heightened awareness may have counterintuitive effects due to the crews being dissatisfied with the after action report. This dissatisfaction may have caused them to indicate a lower score on the questionnaire than they otherwise may have. Contrarily, those battalion chiefs not involved in the incidents may have overstated the fire department's tendencies towards the HRO characteristics because of the recent attention focused on fireground safety. Another limitation is that only chief officers were asked to complete the questionnaire which arguably may not be representative of the entire department. The author intends to submit the questionnaire to the department's labor and management committee to request approval to distribute to the rank and file members of Local 42 of the International Association of Fire Fighters. A limitation of the collection tool itself is that the author was unable to locate a validity analysis for the audit instrument. One of the characteristic's scoring range instructions appear suspect. In the area of sensitivity to operations, the designers, Weick and Sutcliffe, state that the higher the percentage that agrees indicates a higher sensitivity to

operations. This raises the question, higher percentage than what? Nevertheless, the questionnaire does provide valuable data for this research.

Results

1. According to existing literature, what are the common characteristics of HROs?

The literature revealed a set of five characteristics common of HROs. These are (1) a preoccupation with failures rather than successes, (2) reluctance to simplify interpretation, (3) sensitivity to operations, (4) commitment to resilience, and (5) deference to expertise.

2. How well does KCFD exhibit the identified characteristics of high reliability organizations?

3. What are KCFD's limitations as they relate to the identified HRO characteristics?

The method of data collection chosen for these two research questions was an electronic survey emailed to 100% of KCFD chief officers. This included 7 deputy chiefs and 27 battalion chiefs. Eighteen battalion chiefs, five deputy chiefs and one individual who did not indicate rank, responded to the survey. The data from these 24 respondents was used. As shown in Table 1, the responses for each item was averaged and grouped into the identified characteristics. The averages were then summed and the total is displayed in the *Sum of Averages* row. The row labeled *Result* indicates the strength of each characteristic measured by the questionnaire. Weick and Sutcliffe's (2001) offer an interpretation of the scoring ranges. Table 2 illustrates their scoring guidelines.

Table 1

Average Response to Questionnaire Items by Characteristic

Questionnaire Item Number	Mindfulness	Concern for Errors	Reluctance to Simplify	Sensitivity to Operation	Commitment to Resilience	Deference to Expertise
1	2.27	1.71	1.76	79% Agree	2.44	2.67
2	2.32	2.38	1.86	79% Agree	1.82	2.43
3	2.45	2.43	2.0	79% Agree	1.61	2.61
4	2.77	2.52	2.24	62% Agree	2.17	2.0
5	2.41	1.57	1.70	67% Agree	1.89	2.19
6	2.09	1.62	2.0	62% Agree	2.67	1.76
7	2.50	1.48	1.81	92% Agree	2.11	1.95
8	2.27	2.38	2.14	88% Agree	2.50	2.52
9	n/a	1.43	1.81	n/a	2.39	n/a
10	n/a	n/a	1.57	n/a	2.72	n/a
11	n/a	n/a	2.71	n/a	n/a	n/a
12	n/a	n/a	2.43	n/a	n/a	n/a
Sum of Averages	19.08	17.52	24.03	76% Agree	22.32	18.13
Result	Strong	Moderate	Strong		Strong	Strong

Table 2

Questionnaire Score Range and Definition

Mindfulness Safety	Concern for Errors	Reluctance to Simplify	Sensitivity to Operation	Commitment to Resilience	Deference to Expertise
> 16 Strong	> 18 Strong	> 24 Strong	Higher percentage agree indicate a higher sensitivity to operations	> 20 Strong	> 16 Strong
10–16 Moderate	11-18 Moderate	14-24 Moderate		12-20 Moderate	10-16 Moderate
< 10 Weak	< 11 Weak	< 14 Weak		< 12 Weak	< 10 Weak

The questionnaire results imply that KCFD has strong tendencies towards the characteristics of mindfulness, reluctance to simplify explanations, commitment to resilience and deference to expertise. The results also showed a moderate tendency towards a concern for errors. In the area of sensitivity to operations, where the Weick and Sutcliffe state that the higher the percentage that agree, indicates a higher sensitivity to operations, 76% agree that KCFD is sensitive to operations. While the overall scores of the HRO characteristics questionnaire indicated strengths, it is also notable that individual items provide additional more focused data for this research indicating strengths and weaknesses.

The score for item 4 in the mindfulness section, *People at all levels within KCFD value safety* was 2.77 out of a possible high of 3. Seventy-eight percent of the respondents indicated that this statement describes KCFD a great deal, while 22 % indicated to some extent this describes KCFD. In the reluctance to simplify explanations area, item eight, *KCFD employees demonstrate trust for each other,* indicated that 73% of the respondents felt this described KCFD a great deal and 27% indicated to some extent. Item 10 in the commitment to reliance characteristic, *People are able to rely on others*, 74% and 26%, indicated this describes KCFD a

great deal and to some extent respectively. Item 1 in deference to expertise, *People are committed to doing their job well* 73% and 27% indicated this describes KCFD a great deal and to some extent. The scores indicate that KCFD exhibits strength in these areas.

The research did not indicate a significant weakness of any of the characteristics however the 76% indication of sensitivity to operations and some of the specific items that received low average scores deserve a closer examination. As mentioned above as a limitation to this data collection tool, Weick and Sutcliffe do not offer a measurement for 76% agreeing that KCFD is sensitive to operations. The 24% of respondents who disagree that KCFD is sensitive to operations may indicate a weakness to this characteristic. The overall characteristic score for concern for errors indicated only a moderate tendency toward reliability. Specifically, the responses to items 7 and 9, *KCFD managers seek out and encourage bad news* and *People are rewarded if they spot problems, mistakes or errors* respectively, indicated that 64% and 57% indicated that this does not describe KCFD at all. In the reluctance to simplify explanation area, item 5, *People usually prolong their analysis to better understand the nature of problems that come up,* only 67% of the respondents indicated this described KCFD to some extent and 33% reported not at all. While the score indicated a strong tendency in the commitment to resilience area two specific items show a low tendency. Items 3 and 7 were focused on a commitment to training. Item 3, *People have more than enough training for the kind of work they do,* 63% indicated that this describes KCFD to some extent and 27% indicated not at all. Item 7, *KCFD has a concern for building peoples' competence and response repertories,* the responses were 11%, 63% and 26%, not at all, to some extent and a great deal respectively. The common nature of these items and the corresponding low score indicate an area that could strengthen KCFD's tendency towards reliability.

Discussion

The results of this study to determine the strengths and weaknesses of KCFD as they relate to characteristics of highly reliability organizations provide an awareness of the overall mindfulness of KCFD's tendencies towards safety. The results identified many areas of strength that will help KCFD fill specific gaps that were identified by the study as areas of susceptibility.

It is accepted that firefighting operations are dangerous. They are complex and they require technical tasks to be coordinated under rapidly changing conditions. Early research on HROs focused on behaviors of organizations such as naval air operations, nuclear power plants and wildland firefighting. The complexities of KCFD emergency operations and the operations of these organizations are similar in that small lapses can get out of control quickly and result in injury and death. While the Weick and Sutcliffes' (2001) book used to guide this research, *Managing the Unexpected*, was adapted from their earlier research to organizations that work in more stable environments, it provides an excellent tool for measuring an organization's tendencies towards HRO characteristics.

The results of the study seem to align with the reality of KCFD operations. KCFD does have a strong tendency towards high reliability. If we ask the question that Roberts suggests to assess reliability, "how many times could this organization have failed resulting in catastrophic consequences that it did not?" (1990, p. 160), we realize that number is in the thousands. However, the controversy of accidents being inevitable, the number of line of duty deaths KCFD has suffered in the past, the recent near-miss incidents and the low relative scores on specific questionnaire items related to training, indicates continued improvement is required.

The specific areas of strength identified in the research; people value safety, people are free to talk to superiors about problems, KCFD employees demonstrate trust for each other,

KCFD has resources available, employees use their abilities in novel ways and people are able to rely others will help KCFD address the areas of weakness. These specific areas of weakness include, resources are not continually directed at training and retraining people on the properties of the technical system and people do not have more than enough training for the kind of work they do.

Given the results of the study that indicate strong tendencies towards reliability but also identifies areas of weakness it is important to focus resources on these areas that will strengthen KCFD's tendencies towards high reliability. These strategies are discussed in the recommendations that follow.

Recommendations

It is important for KCFD to continue performance in the areas of strength; to probe for answers when lapses in operations occur, to encourage free flow of information between the ranks and to continue to build trust at all levels of the organization. Moreover, it will be important for KCFD to conduct a thorough training needs analysis to determine where best to focus KCFD's training resources. "The training needs analysis is a function recognized as an integral part of any well-designed training program… To utilize most effectively training dollars and resources, one must first determine exactly the location, scope and magnitude of the training need" (Moore & Dutton, 1978, p. 1). The training curriculum should be comprised of programs designed to teach people to adapt to unexpected events. The goal is not to eliminate errors, or unexpected events, but to be able to react appropriately. The training must be designed to allow practical practice of tactics to overcome the unexpected. This will increase the organization's tendency to resiliency.

KCFD's culture currently has a tendency towards high reliability. To strengthen the areas that were identified as less strong, KCFD deputy chiefs should be trained on the findings of this study and be made aware of the strength and weaknesses regarding HRO characteristics. The deputy chiefs should coach their battalion chiefs to encourage HRO behaviors. The department should find novel ways to reward people in the organization for demonstrating these behaviors. These rewards could be acknowledgement for a battalion chief who orders a defensive strategy on an abandon building, or demanding that seat belts be worn 100% of the time with no exceptions. Due to the limitations mentioned earlier in this paper regarding battalion chiefs who may be disgruntled due to after action reports that point out lapses in operations, the recommended coaching should must be conducted with this in mind so as not to exacerbate the situation.

Future readers of this paper should realize that characteristics of HROs are interrelated and that training deficiencies could be an indication of deeper issues. While KCFD has strong tendencies towards reliability, minor deficiencies can result in tragedy. Many of the characteristic are nebulas in nature, but proper training to increase resiliency is the most tangible recommendation for KCFD.

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Appendix A

Overall Assessment of KCFD's "Mindfulness" as it Relates to Safety

For items 1 – 8, please indicate how well each statements describes KCFD?

1 = not at all, 2 = to some extent, 3 = a great deal

1. KCFD as an organization has a sense of susceptibility to the unexpected. _____
2. Everyone in the organization feels accountable for the reliability of conducting our mission safely. _____
3. Leaders of KCFD pay as much attention to managing unexpected events as they do achieving formal organizational goals. _____
4. People at all levels within KCFD value safety. _____
5. We spend time identifying how our activities could harm employees. _____
6. We pay attention to when and why our employees, are customers or other interested parties might feel peeved or disenchanted from our organization. _____
7. There is a widespread agreement among KCFD employees on what we don’t want to go wrong. _____
8. There is a widespread agreement among KCFD employees about how things could go wrong. _____

Appendix B

Assessing the Extent of KCFD's Concern for Correcting Errors

For items 1 – 9, please indicate how well each statements describes KCFD?

1 = not at all, 2 = to some extent, 3 = a great deal

1. KCFD focuses more on our failures than on our successes. _____
2. KCFD regards close calls and near misses as a kind of failure that reveals potential danger rather than as evidence of our success and ability to avoid disaster. _____
3. KCFD treats near misses and errors as information about the health of our operations and tries to learn from them. _____
4. We often update our procedures after experiencing a close call or near miss to incorporate our new experiences and understanding. _____
5. KCFD makes it difficult for people to hide mistakes of any kind. _____
6. People are inclined to report mistakes that have significant consequences even if nobody notices. _____
7. KCFD managers seek out and encourage bad news. _____
8. People are free to talk to superiors about problems. _____
9. People are rewarded if they spot problems, mistakes, or errors. _____

Appendix C

Assessing KCFD's Reluctance to Simplify Explanations

For items 1 – 12, please indicate how well each statement describes KCFD.

1 = not at all, 2 = to some extent, 3 = a great deal

1. People around here take nothing for granted. _____
2. Questioning is encouraged. _____
3. We strive to challenge the status quo. _____
4. KCFD employees feel free to bring up problems and tough issues. _____
5. People usually prolong their analysis to better understand the nature of problems that come up. _____
6. KCFD employees are encouraged to express different views. _____
7. People listen carefully, it is rare that another's view is dismissed. _____
8. People are not shot down for surfacing information that could interrupt operations. _____
9. When something unexpected happens, people are more concerned with listening and considering a complete analysis of the situation than with advocating their view.___
10. We appreciate skeptics. _____
11. KCFD employees demonstrate trust for each other. _____
12. People show a great deal of mutual respect for each other. _____

Appendix D

Assessing KCFD's Sensitivity to Operations

For items 1 – 8, please record agree or disagree for the following statements:

A = Agree, D = Disagree

1. On a day-to-day basis, there is an ongoing presence of someone who is paying attention to what is happening and is readily available for consultation if something unexpected happens. _____
2. If problems occur, someone with authority is always available to act. _____
3. Supervisors readily pitch in whenever necessary. _____
4. During an average day, people come into enough contact with each other to build a clear picture of the current situation. _____
5. People are always looking for feedback about things that aren't going right. _____
6. People are familiar with operations beyond their own job. _____
7. We have access to resources if unexpected surprises come up. _____
8. Manages monitor workloads and are able to obtain additional resources if necessary. _____

Appendix E

Assessing KCFD's Commitment to Resilience

For items 1 – 10, how well does each statements describe KCFD?

1 = not at all, 2 = to some extent, 3 = a great deal

1. Forecasting and predicting the future is not important here. _____
2. Resources are continually directed to training and retraining people on the properties of the technical system. _____
3. People have more than enough training for the kind of work they do. _____
4. KCFD is actively concerned with developing people's skills and knowledge. _____
5. KCFD encourages challenging assignments. _____
6. KCFD employees are known for their ability to use their knowledge in novel ways. _____
7. KCFD has a concern for building peoples' competence and response repertories. _____
8. People have a number of informal contacts that they sometimes use to solve problems. _____
9. People learn from their mistakes. _____
10. People are able to rely on others. _____

Appendix F

Assessment of KCFD's Deference to Expertise

For items 1 – 8, please indicate how well each statements describes KCFD?

1 = not at all, 2 = to some extent, 3 = a great deal.

1. People are committed to doing their job well. _____
2. People respect the nature of one another's job. _____
3. If something out of the ordinary happens, people know who have the expertise to respond. _____
4. KCFD values expertise over hierarchical rank. _____
5. KCFD encourages that those who are most qualified to make decisions make them. _____
6. If something unexpected occurs, the most highly qualified people, regardless of rank, make the decisions. _____
7. People typically "own" a problem until it is resolved. _____
8. It is generally easy for us to obtain expert assistance when something comes up that we don't know how to handle. _____